

STUDY ON LEUKOCYTIC ENZYMES ACTIVITY ENFLUENCED  
BY IONIZING IRRADIATION

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ABSTRACT

Both alkaline phosphatase (APL) and myeloperoxidase (MPO) activities in neutrophilic granulocytes influenced by different doses of ionizing irradiation were studied.

In individuals professionally exposed to the low doses, the enzyme activities were repeatedly determined during the period from 1986-1989. The activities of APL and MPO in patients exposed to the therapeutic irradiation were presented before, during and after the therapy.

Both alkaline phosphatase and myeloperoxidase activities were evidenced by cytochemical staining of capillary blood smears.

INTRODUCTION

Hematopoietic tissue is, according to its radiosensitivity classified into the first group.<sup>1</sup> Therefore, routine peripheral blood analysis is a method of choice in irradiation effects monitoring. Intermittent, low doses induce no depression of bone marrow stem cells (when single doses not higher than 0.5mGy/0.5 mSV/) even during longer time intervals.<sup>2</sup> Therefore, numeric changes of peripheral blood elements are not indicative of initial impairment in routine monitoring of patients. Intracellular enzymes are the most sensitive substances to ionizing irradiation.<sup>3</sup> They are closely related to hematopoietic cells differentiation

and maturation 4. Alkaline phosphatase (APL) and myeloperoxidase (MPO) found in secondary and primary granules of neutrophilic granulocytes are of particular importance .5 Ionizing irradiation induces the inhibition of these enzymes in mature cells as well as its synthesis discontinuation in the course of granulocytopoiesis.6

## MATERIAL AND METHODS

The influence of small doses of ionizing irradiation was examined in professionally exposed workers (radiologic technicians, N= 27). The irradiation extent was evaluated according to the mean annually absorbed dose calculated on the basis of dosimetric control using thermoluminescent pastilles (TLD) for the whole period of the exposure.

The influence of high doses of irradiation may be evaluated in human model only in accidental situations, which are infrequent and unpredictable. Therefore, we conducted our study in cases of therapeutical application of high doses. In order to approximate local therapeutical application of high doses and accidental situation, we had performed experimental dosimetric evaluation of patient's total body dose by thermoluminescent dosimeters (TLD) as well as by dose measurement on RandoPhantom's surface.

Alkaline phosphatase (APL) and myeloperoxidase (MPO) activities were determined by cytochemical staining of capillary blood smear 7. The activity was calculated according to the intensity of staining and expressed as a score of cell count product and stain index per 100 neutrophilic granulocytes, i.e. semiquantitatively 7, 8.

The activity of the examined enzymes in workers exposed to low-dose irradiation was determined repeatedly during the period from 1986 till 1989, and in patients therapeutically exposed to the irradiation, APL and MPO values are presented before, during and

after the therapy 8.

## RESULTS AND DISCUSSION

The mean annually absorbed dose obtained for ten-year exposure period was 4.5 mGy, while for thirteen-year exposure period it was 5.59 mGy. Accordingly, professionally exposed workers continually and absorbed approximately the same, low doses.

The estimated effective equivalent therapeutical dose for the whole 6-week period of therapy was 2.6 Sv, with 1.3 Sv for the 3-week period.

APL scor values in professionally exposed workers after 10 and 13 years of exposure were mutually compared, and also compared with the controls having 10 and 13 years of service. The results are presented at Table 1.

Table 1.

| <u>APL scor in exposed and control groups</u> |    |                         |               |
|---|----|-------------------------|---------------|
| Observed<br>groups                            | N  | <u>Years of Service</u> |               |
|   |    | <u>10 yrs</u>           | <u>13 yrs</u> |
| E   | 27 | 39,93                   | 39,53         |
| C   | 16 | 45.50                   | 47.81         |
|   |    | 0.62NS                  | 0.11NS        |

Mean MFO scor values are identically compared and presented at the Table 2.

Table 2.

MFO scor in exposed and control groups

| Observed groups | N  | <u>Years of Service</u> |         |
|-----------------|----|-------------------------|---------|
|                 |    | 10 yrs.                 | 13 yrs. |
| E               | 27 | 132.29                  | 91.79   |
| C               | 16 | 168.0                   | 170.0   |
| p               |    | 0.001 S                 | 0.001 S |

As it may be seen from Tables 1 and 2, there was no significant difference in AFL scor in controls. Duration of exposure had no statistic significance.

MFO scor was significantly lower in the exposed workers, decreasing with the duration of exposure (Figure 2).

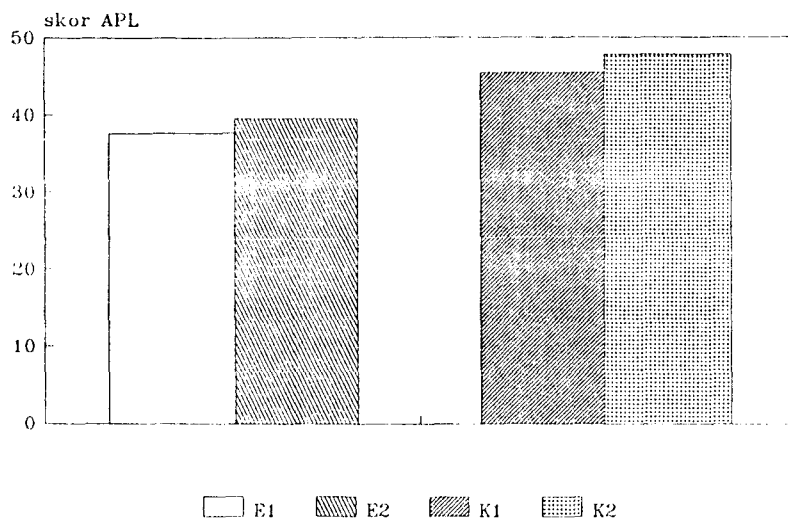
Table 2 reviews mean AFL and MFO scor values obtained from 18 patients, therapeutically irradiated due to the tumor for 6 weeks, before, during and after the therapy:

Table 3.

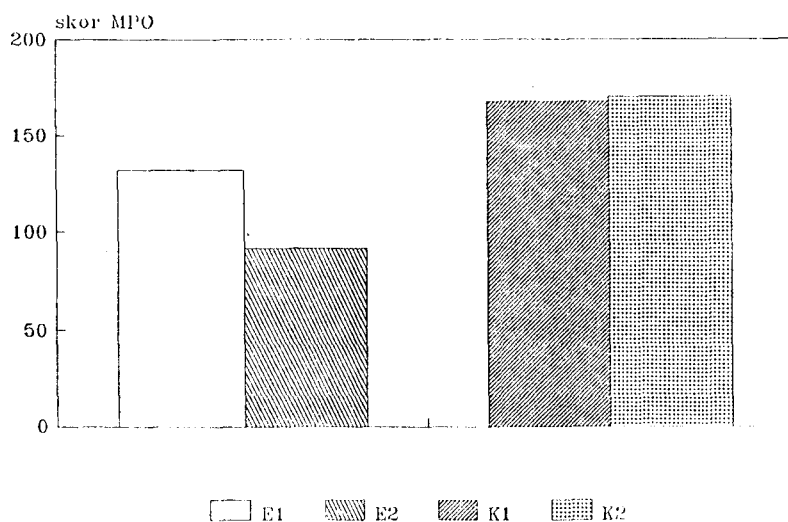
AFL and MFO scor in Therapeutically Irradiated Patients

| AFL,MFO       | N  | Before RTh | Rurin RTh | After RTh |
|---------------|----|------------|-----------|-----------|
| X SCOR<br>AFL | 18 | 66.61      | 85.11     | 34.17     |
| X SCOR<br>MFO | 18 | 141.77     | 109.20    | 73.0      |

The analysis using Paired T-test revealed: the difference between mean values of both enzymes showed significance of p 0.05, before, during and after the therapy. AFL values significantly increased during the



**Figure 1.**  
APL SCOR in exposed and control group after 10 and 13 years



**Figure 2.**  
MPO SCOR in exposed and control group after 10 and 13 years

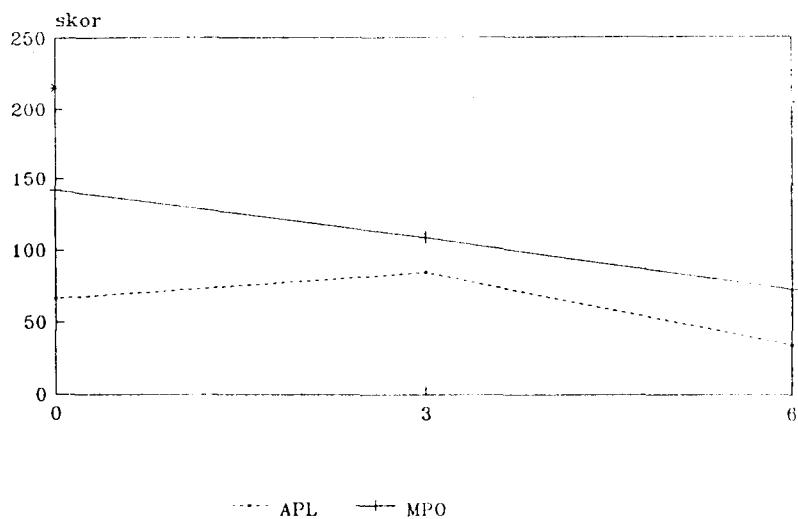


Figure 3.

APL and MPO scor tendencies influenced  
by high doses during the 6-week  
irradiation therapy

therapy, with sudden decrease after the irradiation, while significant decrease of MFO values was observed both during and after the irradiation when compared to pre-irradiation values (Figure 3).

## CONCLUSION

Our results revealed significant decrease of MFO values under the influence of irradiation, while APL values decrease, influenced by low doses was insignificant. After the initial increase, significant fall was observed induced by high doses.

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